



NTSB National Transportation Safety Board

Collaboration:

Thinking

Outside of the Box

Presentation to:

30th International System Safety
Conference

Name: Christopher A. Hart

Date: August 7, 2012

Outline

Aviation Collaboration Success Story

- By aircraft manufacturers**
- At the industry level**

Win-win: Collaboration Can Improve Both Safety and Productivity

Applicability to Other Industries?



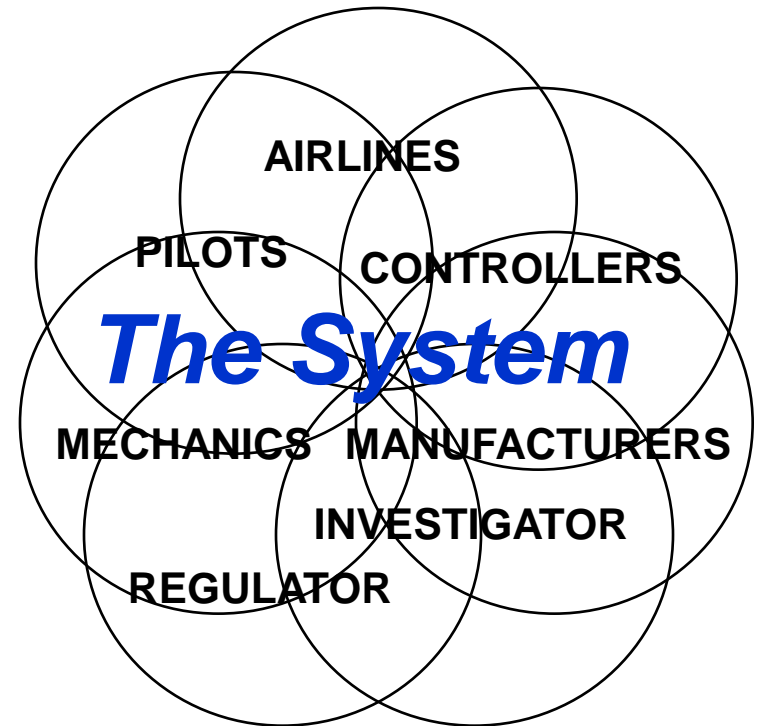
The Challenge: Increasing Complexity

- **More System**

- Interdependencies***

- Large, complex, interactive system
 - Often tightly coupled
 - Hi-tech components
 - Continuous innovation
 - Ongoing evolution

- **Risk Management Issues Are More Likely to Involve**
Interactions Between Parts of the System



Effects of Increasing Complexity:

More “Human Error” Because

- **System More Likely to be Error Prone**
- **Operators More Likely to Encounter Unanticipated Situations**
- **Operators More Likely to Encounter Situations in Which “By the Book” May Not Be Optimal (“workarounds”)**



The Result:

Front-Line Staff Who Are

- Highly Trained
- Competent
- Experienced,
- Trying to Do the Right Thing, and
- Proud of Doing It Well

. . . Yet They Still Commit

**Inadvertent
Human Errors**



The Solution: System Think

***Understanding how a
change in one subsystem
of a complex system may
affect other subsystems
within that system***



Objectives:

Make the System

***(a) Less
Error Prone***

and

***(b) More
Error Tolerant***



The Health Care Industry

To Err Is Human:

Building a Safer Health System

“The focus must shift from blaming individuals for past errors to a focus on preventing future errors by designing safety into the system.”

Institute of Medicine, Committee on Quality of Health Care in America, 1999



Major Paradigm Shift

How It Is Now . . .

You are highly trained

and

If you did as trained, you
would not make mistakes

so

You weren't careful
enough

so

You should be **PUNISHED!**

How It Should Be . . .

You are human

and

Humans make mistakes

so

Let's *also* explore why the
system allowed, or failed to
accommodate, your mistake

and

Let's **IMPROVE THE SYSTEM!**



“System Think” via Collaboration

Bringing all parts of a complex system together to collaboratively

- **Identify potential issues**
- ***PRIORITIZE* the issues**
- **Develop solutions for the prioritized issues**
- **Evaluate whether the solutions are**
 - **Accomplishing the desired result, and**
 - **Not creating unintended consequences**



Aircraft Manufacturer “System Think”

Aircraft manufacturers are increasingly seeking input, from the earliest phases of the design process, from

- *Pilots* (User Friendly)
- *Mechanics* (Maintenance Friendly)
- *Air Traffic Services* (System Friendly)



Some System Challenges

- **Cali, Colombia, 1996**
- **Turkish Airlines Flight 1951, 2009**
- **Washington Metro, 2009**
- **Landing on the Hudson, 2009**
- **Air France Flight 447, 2009??**



Inadequate System Think

- 1995 – Cali, Colombia
- Risk Factors
 - *Night*
 - *Airport in deep valley*
 - *No ground radar*
 - *Airborne terrain alerting limited to “look-down”*
 - *Last minute change in approach*
 - *More rapid descent (throttles idle, spoilers)*
 - *Hurried reprogramming*
- Navigation Radio Ambiguity
- Spoilers Do Not Retract With Power



Recommended Remedies Include:

- Operational
 - *Caution re last minute changes to the approach!!*
- Aircraft/Avionics
 - Enhanced ground proximity warning system
 - Spoilers that retract with max power
 - Require confirmation of non-obvious changes
 - Unused or passed waypoints remain in view
- Infrastructure
 - Three-letter navigational radio identifiers
 - Ground-based radar
 - Improved reporting of, and acting upon, safety issues

Note: All but *one* of these eight remedies address *system* issues



Turkish Airlines Flight 1951

- **The Conditions**

- Malfunctioning left-side radar altimeter
- Pilots selected right-side autopilot
- Aircraft vectored above glideslope
- Autothrust commanded throttles to idle
- Unknown to pilots, right-side autopilot was using left-side radar altimeter
- Autothrust hampered attempted go-around



- **Queries:**

- Autopilot defaults to same-side altitude information?
- Tell pilots source of information, let them select?



Metro, Washington DC

- **The Conditions**

- Electronic collision prevention
- Parasitic electronic oscillation
- Stopped (struck) train became electronically invisible
- Following (striking) train accelerated
- Stopped train was on curve



- **Queries:**

- Train “disappearance” warning in dispatch center?
- Train “disappearance” warning in following trains?

- **One Lesson Learned:**

- Over-warning may be worse than *no* warning



Landing on the Hudson

- **Complete and irreparable failure of both engines after takeoff**
- **No training or checklist, but previous glider experience**
- **Pilots did not know about phugoid damping in software**
- **Phugoid damping did not allow full nose-up alpha**
- **Pilots less able to reduce vertical impact speed**



Air France Flight 447??

- **The Conditions**

- Cruise, autopilot engaged
- Night, in clouds, turbulence, coffin corner
- Pitot tubes blocked with ice
- Autopilot inoperative without airspeed
- Alpha protections disabled without airspeed
- Pilots' responses inappropriate



- **Query**

- Pilot training re loss of airspeed information in cruise?



Collaboration at the Aviation System Level?

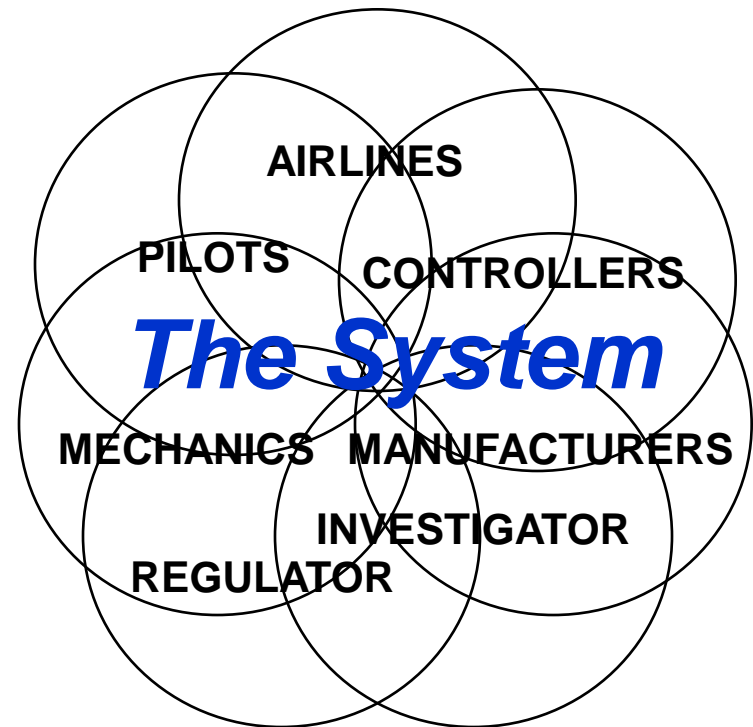
- Mid-1990's, U.S. fatal commercial accident rate, although commendably low, had stopped declining
 - Volume of commercial flying was projected to double within 15-20 years
- Simple arithmetic: Doubling volume x flat rate = *doubling of fatal accidents*
- Major problem because public pays attention to the *number* of fatal accidents, not the *rate*



Commercial Aviation Safety Team (CAST)

Engage All Participants In Identifying Problems and Developing and Evaluating Remedies

- Airlines
- Manufacturers
- Air Traffic Organizations
- Labor
 - *Pilots*
 - *Mechanics*
 - *Air traffic controllers*
- Regulator(s)



Collaboration Success Story

65% Decrease in Fatal Accident Rate,
1997 - 2007

largely because of

System Think

fueled by

***Proactive Safety Information
Programs***

P.S. Aviation was already considered **VERY SAFE** in 1997!!



Major Paradigm Shift

- **Old: The regulator identifies a problem, develops solutions**
 - Industry skeptical of regulator's understanding of the problem
 - Industry fights regulator's solution and/or implements it begrudgingly

- **New: Collaborative “System Think”**
 - Industry involved in identifying problem
 - Industry “buy-in” re solution because everyone had input, everyone's interests considered
 - Prompt and willing implementation
 - Solution probably more effective and efficient
 - Unintended consequences much less likely

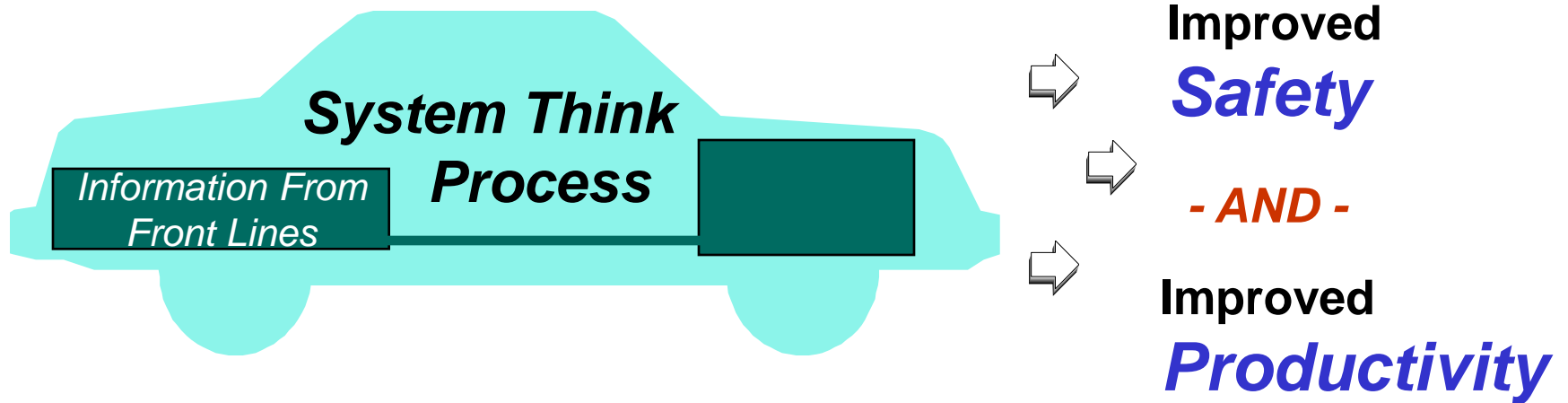


Challenges of Collaboration

- Human nature: “I’m doing great . . . *the problem is everyone else*”
- Differing and sometimes competing interests
 - Labor-management issues between participants
 - Participants are potential adversaries
- Regulator not welcome
- Not a democracy
 - Regulator must regulate
- Requires all to be willing, in their enlightened self-interest, to leave their “comfort zone” and think of the System



Icing on the Cake: A Win-Win



The Pleasant Surprise

- Conventional Wisdom:

Improvements that reduce risk usually
also reduce productivity

- The Reality:

Risk reduction programs are usually a **NON-STARTER**
if they hurt productivity

- Lesson Learned from the CAST process:

Risk can be reduced in a way that also results in
immediate productivity improvements



Aviation Win-Win: Transferable to Other Industries?

- Other Transportation Modes**
- Nuclear Power**
- Chemical Manufacturing**
- Petroleum Refining**
- Financial Industries**
- Healthcare**
- Others**



Thank You!!!



Questions?

